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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/088,975	08/13/2002	Thomas L Ritzdorf	SEMT118781	6706

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EXAMINER

LEADER, WILLIAM T

ART UNIT	PAPER NUMBER
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1795

MAIL DATE	DELIVERY MODE
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01/09/2008

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/088,975	Applicant(s) RITZDORF ET AL.	
	Examiner William T. Leader	Art Unit 1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 31 October 2007.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,3-5,7,8,11-15,17-22,24-26 and 28-39 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,3-5,7,8,11-15,17-22,24-26 and 28-39 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/ are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on October 31, 2007, has been entered.

2. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claim Rejections - 35 USC § 103

3. Claims 1, 3-5, 7, 8, 11-15, 17-22, 24-26, 28-31, 33-37 and 39 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dubin et al (5,972,192) combined with either Ueno (6,245,676) or Jernstedt et al (2,678,909), newly cited, and further in view of in view of Ding et al (5,328,871) with either Sonnenberg et al (5,223,118) or Creutz (3,770,598) for the reasons of record and in view of the following comments.

4. Claim 32 is rejected under 35 U.S.C. 103(a) as being unpatentable over Dubin et al (5,972,192) combined with either Ueno (6,245,676) or Jernstedt et al (2,678,909) and further in view of in view of Ding et al (5,328,871) with either Sonnenberg et al (5,223,118) or Creutz (3,770,598) as applied to claims 1, 3-5, 7, 8, 11-15, 17-22, 24-26, 28-31, 33-37 and 39 above, and additionally in view of in view of Ting et al (5,969,422) for the reasons of record and in view of the following comments.

5. Claim 38 is rejected under 35 U.S.C. 103(a) as being unpatentable over Dubin et al (5,972,192) combined with either Ueno (6,245,676) or Jernstedt et al (2,678,909) and further in view of in view of Ding et al (5,328,871) with either Sonnenberg et al (5,223,118) or Creutz (3,770,598) as applied to claims 1, 3-5, 7, 8, 11-15, 17-22, 24-26, 28-31, 33-37 and 39 above, and additionally in view of Uzoh et al (6,251,251) for the reasons of record and in view of the following comments.

6. Applicant has amended claim 1 to recite that the second time period and a level of reverse electroplating power supplied during the second time period are selected to substantially desorb accelerator agent from the deposited metal structure to limit deposition of a bump. As recited in lines 15-16, the second time period is greater than or equal to ten seconds. The Jernstedt et al patent (2,678,909), newly cited is being applied in the rejections alternatively with Ueno.

Jernstedt is directed to electroplating metals such as copper using electric current which periodically reverses polarity (i.e., uses forward and reverse electroplating power). A waveform of the applied current is shown in figure 2. The cathodic or forward current is applied for a time period of 45 seconds or more. The anodic or reverse current is applied for a time period of not less than 30% of the time period during which the cathodic current is applied. For a 45 second forward time period, the reverse time period would be 13.5 seconds or more. Applicant's claimed range of 10 seconds or more significantly overlaps this range. Jernstedt et al disclose that the use of the periodically reversed current results in outstanding smoothness and levelness, and improved uniformity of thickness. See column 3, lines 46-74. Dubin et al disclose the use of forward-reverse plating of copper to substantially voidlessly fill a high aspect ratio opening using a plating solution that may contain a brightening agent (column 6, lines 28-34). As indicated at page 4 of the office action mailed on September 21, 2007, example 2 of Dubin et al discloses anodic (reverse) current density of about 3 mA/cm² to about 160 mA/cm². Applicant's dependent claim 39 recites that the reverse current density is greater than about 3 mA/cm². The value recited by applicant in claim 39 falls within the range disclosed by Dubin et al. It would have been obvious at the time the invention was made to have utilized the forward-reverse plating time disclosed by Jernstedt et al to perform the forward-reverse plating in the process of Dubin et al because improved smoothness,

levelness and uniformity would have been obtained as taught by Jernstedt et al. Since the second time period and level of reverse electroplating power recited by applicant overlap or fall within the ranges suggested by Jernstedt et al and Dubin et al, the resulting effects such as the desorption of accelerator agent would have been expected to be the same. Independent claims 24, 25, 26 and 28 have been amended in a manner similar to claim 1.

7. As explained in the office action of September 21, 2007, the term brightener (as used by Dubin et al) is generally used synonymously with accelerator. This is illustrated by Ding et al patent which refers to "brighteners/accelerators" (column 9, line 36). Sonnenberg et al identified compounds claimed by applicant as accelerator agents as brighteners. Thus, the electroplating solution used by Dubin et al contains an accelerator agent as recited by applicant.

8. As indicated at page 2 of the office action mailed on May 18, 2006, the Ueno patent discloses the use of electroplating power which is periodically reversed. Waveforms are shown in figures 3-6. During time periods t1 and t3 forward plating power is applied. During time periods t2 and t5 reverse plating power is applied. Ueno teaches that these time periods are chosen to be less than about 10 seconds. See column 10, lines 13-23 and column 11, lines 55-61. This time period overlaps the range of the second time period recited by applicant in the region of ten seconds. As noted above, example 2 of Dubin discloses anodic (reverse) current density of

about 3 mA/cm² to about 160 mA/cm². The value of current density (electroplating power) recited by applicant falls within this range. Choice of a value of time and electroplating power from within the ranges disclosed by Ueno and Dubin would have been prima facie obvious. Since the second time period and level of reverse electroplating power recited by applicant overlap or fall within the ranges suggested by Ueno and Dubin, the resulting effects such as the desorption of accelerator agent would have been expected to be the same.

Response to Arguments

9. Applicant's arguments have been carefully considered but are not deemed to be persuasive. At page 17 applicant argues that Ueno teaches a wholly different process of electroplating copper interconnects than Dubin. This argument is not convincing. Dubin is directed to a process for forming wiring interconnects on a semiconductor device by voidlessly filling high aspect ratio openings with copper (column 4, lines 32-35). The copper may be voidlessly deposited by an electroplating process using forward-reverse pulse plating (column 6, lines 28-31). The Ueno patent is also directed to a process for depositing interconnects on a semiconductor device by electroplating copper into openings. Ueno recognizes that the formation of voids is a problem as shown in figure 14 which illustrates a prior art process (column 9, lines 20-24). Ueno teaches that the pattern of current having forward

and reverse changing polarity may be adjusted with the view of preventing the production of voids (column 11, lines 28-31). Thus, Ueno and Dubin are directed to the same basic process.

10. At page 17 of the Remarks, applicant further argues that there is no apparent reason to combine Dubin and Ueno to arrive at the claimed invention. This argument is not persuasive. As indicated above, both Dubin and Ueno disclose the use of electroplating copper using electric current in which the polarity is periodically reversed to form voidless deposits. One of ordinary skill in the art would have recognized that it would have been desirable to have optimized electric current parameters in Dubin using current parameters disclosed by Ueno as advantageous for avoiding the formation of voids.

11. At page 15 of the Remarks, applicant points out that Dubin does not so much as contemplate the phenomenon of 'momentum plating'. In response to applicant's argument, the fact that applicant has recognized another advantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious. See *Ex parte Obiaya*, 227 USPQ 58, 60 (Bd. Pat. App. & Inter. 1985).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to William T. Leader whose telephone number is

571-272-1245. The examiner can normally be reached on Mondays-Thursdays and alternate Fridays, 7:30-4:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Susy Tsang-Foster can be reached on 571-272-1293. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Harry D. Wilkins, III/
Harry D. Wilkins, III
Primary Examiner
Art Unit 1795

WL

William Leader
December 31, 2007